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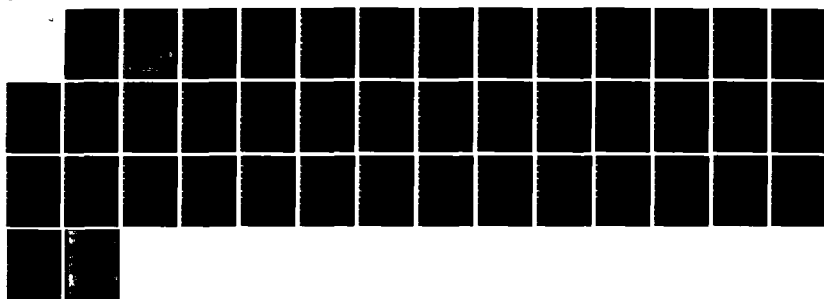
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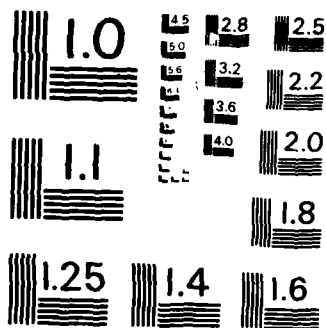
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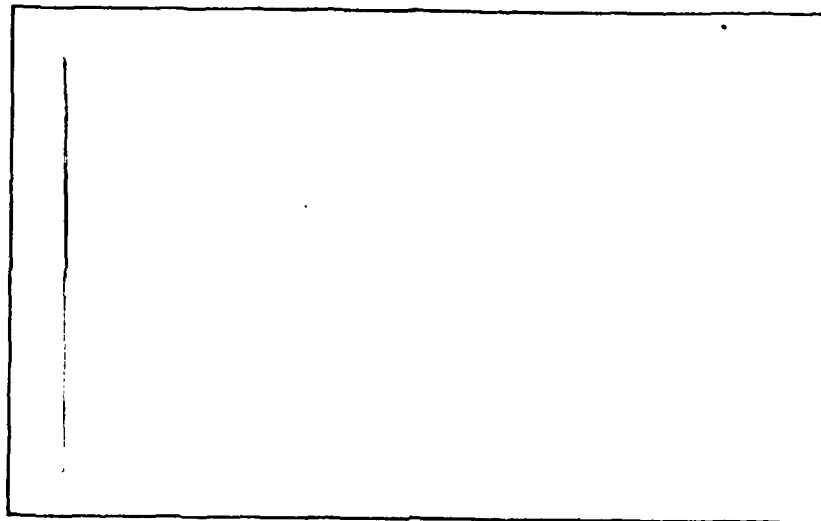
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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 115-3	2. GOVT ACCESSION NO. AD-A42367	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) AN EVALUATION OF THE WSSC COST ALLOCATION ALGORITHMS II: INSTALLATION SUPPORT		5. TYPE OF REPORT & PERIOD COVERED Technical Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Karen L. Evans Robert L. Gardner Dennis E. Smith		8. CONTRACT OR GRANT NUMBER(s) F33600-80-C-0554
9. PERFORMING ORGANIZATION NAME AND ADDRESS Desmatics, Inc. P.O. Box 618 State College, PA 16804		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS HQ AFLC/MML(VAMOSC) Wright-Patterson AFB, OH 45433		12. REPORT DATE June 1983
		13. NUMBER OF PAGES 34
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report)  Distribution of this report is unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) VAMOSC Cost Allocation O&S Costs		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  This report by Desmatics, Inc. is the second in a series of volumes which review procedures used by the Weapon System Support Cost (WSSC) subsystem of the Air Force Visibility and Management of Operating and Support Costs (VAMOSC) system to allocate operating and support costs to Air Force weapon systems. This volume presents the results of an examination of algorithms and data used by WSSC to allocate base installation support costs. WSSC processes were		

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/examined in relation to cost accounting practices, Department of Defense requirements, and results of related studies.

Desmatics makes several specific recommendations for changes in WSSC processing, and raises several questions for review by Office of VAMOSC personnel pursuant to possible development of additional changes. Desmatics' conclusions and recommendations are listed in this report, together with accompanying comments from the Office of VAMOSC.,

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DESMATICS, INC.

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P. O. Box 618

State College, Pa. 16801

Phone: (814) 238-9621

*Applied Research in Statistics - Mathematics - Operations Research*

AN EVALUATION OF THE WSSC  
COST ALLOCATION ALGORITHMS  
II: INSTALLATION SUPPORT

by

Karen L. Evans  
Robert L. Gardner  
Dennis E. Smith

TECHNICAL REPORT NO. 115-3

JUN 26 1984

Original Draft      March 1982

Final Draft        June 1983

Prepared under Contract No. F33600-80-C-0554

## EXECUTIVE SUMMARY

This report by Desmatics, Inc. is the second in a series of volumes which review procedures used by the Weapon System Support Cost (WSSC) subsystem of VAMOSC to allocate operating and support costs to Air Force weapon systems. This volume presents the results of an examination of algorithms and data used by WSSC to allocate base installation support costs.

WSSC processes were examined in relation to cost accounting practices, Department of Defense requirements, and results of related studies. Based on this examination, Desmatics recommends that total base installation support costs be broken down into fixed and variable portions. This report suggests a regression procedure that could be implemented to accomplish this objective, pending further testing to be reported on in Volume VII. Desmatics further recommends that the variable costs should be allocated to an MDS on the basis of the ratio of MDS-related personnel to all aircraft mission personnel.

This report also reviews the criteria for selection of input data for processing. Two questions are discussed. The first is whether or not cost records with EEIC's of 6X4XX (relating to medical/dental costs) duplicate costs covered by the Surgeon General's Factor and ought to be excluded. Secondly, since WSSC disregards the Responsibility Center (RC) code entirely, support costs incurred by the host for tenant organizations will be improperly levied. Desmatics recommends that the Office of VAMOSC personnel review these areas to insure that costs are not counted twice, and that no costs are misclassified.

WSSC procedures have also been reviewed for conformance with CAIG requirements. One requirement not currently being met is that work load

distribution data for installation support be included in the report output.

In summary, Desmatics makes several specific recommendations for changes in WSSC processing, and raises several questions for review by Office of VAMOSC personnel pursuant to possible development of additional changes. Action on these recommendations should bring WSSC procedures more in compliance with DOD requirements, and in line with conventional accounting practices.



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## I. INTRODUCTION

Desmatics, Inc. under Contract No. F33600-80-C-0554, is conducting an evaluation of the cost allocation algorithms employed in the Weapon System Support Cost (WSSC) subsystem of VAMOSC, the Air Force Visibility and Management of Operating and Support Costs system. This report is the second in a set of volumes which discuss the scope and findings of the Desmatics evaluation effort.

The purpose of this report is to evaluate the WSSC procedures for allocating installation support costs to Air Force aircraft weapon systems. The report reviews conventional cost accounting treatment of overhead costs, collates these practices with CAIG and DOD requirements, examines WSSC installation support algorithms and recommends some changes in them. As discussed in Volume I [8], this review of the WSSC process is restricted to a qualitative evaluation, which examines the system logic for face validity. It evaluates the reasonableness of the procedures and determines whether or not they will produce equitable results. A quantitative evaluation to determine mathematical validity will follow in Volume VII when necessary data has been collected and analyzed.

Based on its research, Desmatics has made a number of specific recommendations which are enumerated in Section V of this report. The corresponding responses and comments of the Office of VAMOSC accompany each recommendation.

The Statement of Work under which this Desmatics study was initiated calls for the evaluation of the WSSC system algorithms as set forth in system specifications dated June 1980. The WSSC system has evolved almost continually since that time, reflecting improvements that were made in

virtually every aspect of the system logic prior to the first production runs in April 1982. Additional modifications and enhancements were made to WSSC between the first production run in 1982 and the second run made in April 1983, and more are planned for the immediate future.

Desmatics recognizes that to restrict its evaluation to the June 1980 baseline would significantly limit the usefulness of its findings. Accordingly, Desmatics has kept pace with the evolution of the WSSC system, and has attempted to reflect the significant system changes in its study, specifically in those instances where a given cost was computed by different algorithms in two (or more) years. As a result, the documentation of Desmatics' findings is more complex than might otherwise be the case. The reader may expect frequent encounters with the phrases "for FY81," "for FY82" and "for FY83."

Desmatics has endeavored to have this volume reflect the current status of installation support cost allocation algorithms within the WSSC system. The authors feel that this has been accomplished. However, the reader must realize that should future WSSC system changes impact on the algorithms discussed, portions of this report may become outdated.

## II. BACKGROUND

Installation support costs include the costs of manpower, materials and services required for the daily operation of an Air Force base. These costs are incurred by the host organization primarily for the benefit of its tenant organizations, and are generally referred to as overhead or indirect costs. The nature of these costs may be inferred from the sub-categories of installation support costs which WSSC provides in its output products and from the structure of the codes used to select cost elements from the ABDS files and identify personnel within MPC files.

WSSC defines installation support costs in terms of three program elements: base operating support (BOS), real property maintenance (RPM), and base communications (COM). These categories include such costs as supply services, transportation, accounting and finance, civil engineering and base communications. As overhead functions, these services are supplied primarily by the organizations within the deputy commander for resources (DCR), the tenant Air Force Communication Command unit, and the combat support group. This support is provided to organizations under the deputy commander for operations (DCO) and the deputy commander for maintenance (DCM) within each tenant command resident at the base. Although installation support costs are not incurred by active mission organizations directly, they are incurred in order to sustain mission activity and as such must be attributed to the missions they support. Attribution of indirect costs requires that allocation procedures be adopted to distribute costs equitably among the supported organizations.

The following sections draw from relevant references to define indirect costs more precisely in order to facilitate the definition of

equitable allocations. Specifically, they discuss the definitions of fixed and variable indirect costs, cost drivers of variable indirect costs, and common indirect costs.

#### A. FIXED AND VARIABLE INDIRECT COSTS

Indirect costs may be broken down into fixed and variable portions. Cost accountants in business and industry define variable indirect costs as those which vary with changes in the size or activity level of production divisions, and fixed costs as those that are independent of changes in production level. In general, there is a relationship of the former costs to an intervening variable that responds to activity level changes and that, in turn, generates a need for a change in support level or overhead [2,5,9].

The armed services are required by Department of Defense MBO 9-2 [4] to develop a system to identify cost elements which taken as a whole "... describe the total variable cost to DOD of operating and supporting the weapon system..." The aggregation of costs by weapon system is undertaken partly in order to facilitate acquisition discussions for DSARC and to provide a historical context from which trade-off decisions can be made when weapon systems are compared. When only variable costs are included, DSARC has comparable data for existing and proposed systems. The guidelines from CAIG [3] indicate that installation support costs which are incurred by the host on behalf of a weapon system should be included in weapon system accounting if they would not be incurred by the host were the weapon system moved elsewhere.

## B. COST DRIVERS OF VARIABLE INDIRECT COSTS

In practical terms, there is no clean line separating fixed costs from variable costs associated with flying operations support. Real property maintenance offers a good example of the difficulty of separating these costs. The mere existence of a base, without any operating mission, requires facility maintenance such as plumbing repairs. Addition of a flying unit to the base increases the wear and tear on the base and generates increased costs. Further additions generate further cost increases. There is a minimal level of cost that must be considered fixed. A large portion of the total plumbing cost, however, is variable. There is no directly observable way of measuring each component of cost separately. At best, only estimates of the fixed and variable portions of the total installation support can be computed.

One approach to the problem of separating fixed and variable indirect costs is to focus on how the variable costs behave under a range of conditions. Variable overhead responds to variations in flying or other operations through one or more intervening variables that are directly, physically associated with operation. These intervening variables are called cost drivers. As they vary, they cause changes in the indirect costs. Therefore, changes in variable indirect costs can be inferred from observed changes in the cost drivers. It is necessary, however, to know which factors drive variable installation support costs in order to separate them from the total overhead cost burden.

A recent study [10] was conducted to calculate the regression equation that best predicted installation support costs for domestic naval bases. From a starting set of seventy variables, it was found that a set of five

variables accounted for 90% of the variability of installation support costs among 144 naval bases. Those five variables were:

1. The average number of military personnel present at a base;
  2. The number of civilian personnel employed at the base;
  3. The total floor square footage of the buildings on the base;
  4. The total BTU's of energy consumed at the base including electricity, coal and natural gas, excluding aviation fuel;
- and 5. The total land acreage of the base.

The use of these variables in a regression equation means that they correlate well enough with installation support to predict costs for a base. It does not necessarily imply a causal relationship, i.e., that they are cost driving factors. However, this study provides a lead to the identification of installation support cost drivers.

In general, the land acreage of a base generates fixed costs and does not respond directly to changes in flying activity level. Energy consumption is itself an overhead cost, related to flying activity through active mission personnel who are the predominant energy consumers. Total building square footage may be a cost driver, especially of real property maintenance costs. However, building space may not be readily associated with a given mission. Also space allocations are generally not unique to an MDS and are not directly associated with variations in the flying activity of a given MDS.

The remaining two variables relate to personnel: military and civilian. The distinction between military and civilian personnel is coincidental with the distinction between supported and supporting personnel. In the Navy, civilians primarily carry out the support function. To say that support costs increase as the number of support personnel increases is not very useful, as there is no means for tying the support function to

the operating missions. On the other hand, this study suggests that the number of supported personnel at a base is a major cost driver of installation support costs. Supported personnel have a direct tie to flying activity and are the primary recipients of installation support. Another study [11] reinforces the contention that support costs should be allocated in proportion to supported strengths.

None of the five variables identified in the cited Navy study was tied to weapon system operations at the MDS level. In order for WSSC to use a variable as the basis for allocating costs, it is necessary that such a relationship exist. Within the Air Force it is possible to associate subgroups of supported personnel with specific MDS's. This characteristic, when combined with its high face validity, makes supported strength a good basis for the allocation of support costs to MDS's. A later section of this report will show how this measure can also be used in separating the fixed and variable portions of total support costs.

#### C. INDIRECT COSTS AS COMMON COSTS

Another characteristic of indirect overhead costs is that they are usually shared among several areas of operation. Cost accountants refer to these costs as common costs because they are incurred in common by more than one product area. Allocation conventions need to be defined to separate these common costs so that they may be charged fairly to different operational organizations [1,2]. This is the case with base installation support. At some bases overhead costs are shared among several operating missions. There is no clear demarcation between the support effort provided for flying operations and maintenance, and that provided



for other tenant missions. Costs for these services are not tracked separately by mission in the base accounting system. The discussion of the relationship between supported personnel and installation support costs implies that the shared costs be apportioned among operating missions according to the number of supported personnel associated with each. Applying this principle to WSSC implies that the flying mission should, therefore, absorb variable installation support costs in the same proportion that the number of supported personnel associated with flying operations bears to the total number of supported personnel at the base.

Indirect costs are also shared among MDS's. Again, the number of supported personnel is useful in apportioning the cost burden fairly. The natural extension of the general rule to the MDS level implies that each MDS present at a base should bear a share of the variable flying mission support cost in proportion to the share of supported aircraft-related personnel it represents.

### III. PROCESS DESCRIPTION

This section examines the algorithm WSSC currently uses to allocate installation support costs to MDS's. It also reviews the sources of data used as input for these algorithms [12,13,16].

#### A. THE WSSC ALGORITHM FOR INSTALLATION SUPPORT

Installation support costs are reported separately for each base within the relevant commands. Costs for each base are selected from the ABDS input file using Program Element and RC/CC codes. (See Section B for more detail.) For FY81, WSSC used a two-step process to allocate costs to the MDS level: the first based on strength ratios, the second on flying operations ratios.

The costs reported in the ABDS file are the total base support costs incurred on behalf of all tenant missions at the base, not just the aircraft mission. For FY81 the first step in the WSSC algorithm was to estimate the portion of these total costs that were assigned to the aircraft mission. To do this WSSC used a ratio of personnel counts as follows:

$$\frac{\text{Aircraft Operations \& Maintenance Strength}}{\text{Total Base Population}} .$$

Multiplying the total base installation support cost figure by this ratio resulted in the costs that were attributed to the aircraft mission. These costs were then allocated to the MDS's represented at the base.

It should be noted that all support costs, not just variable costs, were allocated. Also, by using the total base population in the denominator of the personnel ratio, WSSC implicitly apportioned some of the support

costs to installation support organizations. WSSC's apportioning of costs is represented graphically in Figure 1. The relative sizes of the three major segments are determined by the relationships among the personnel counts.

For FY81, the second step in the algorithm allocated the aircraft mission costs among the MDS's at the base. To do this, WSSC used measures of the relative flying activity level (flying hours) and base fleet size (possessed hours) of the MDS. The rationale was that the more active MDS's and/or those with more planes should bear a greater share of the installation support costs. The allocation of these costs by WSSC to the MDS's was based on the general flying operations ratio discussed in Volume I [8] of this report series. The specific ratio used in FY81 for installation support was:

$$0.5 \left[ \frac{\text{Flying Hours (CMD/GELOC/MDS)}}{\text{Flying Hours (GELOC)}} + \frac{\text{Possessed Hours (CMD/GELOC/MDS)}}{\text{Possessed Hours (GELOC)}} \right].$$

The aircraft mission support costs were multiplied by the ratio computed for each MDS/Command combination at the base. The result was the installation support cost that was attributed to each MDS/Command combination.

In FY82 the basis for allocating installation support costs to MDS's was changed from flying operations ratios to supported personnel strength ratios. WSSC associates crew personnel to MDS's using, when necessary, an allocation procedure described in Volume III [6]; allocates below depot maintenance personnel to MDS's using maintenance manhour ratios as described in Volume IV [7]; allocates aircraft system security personnel using possessed hours as described in Volume III; and allocates command staff and other unit personnel based on flying operations ratios as described in Volume III.

Total Installation Support Costs

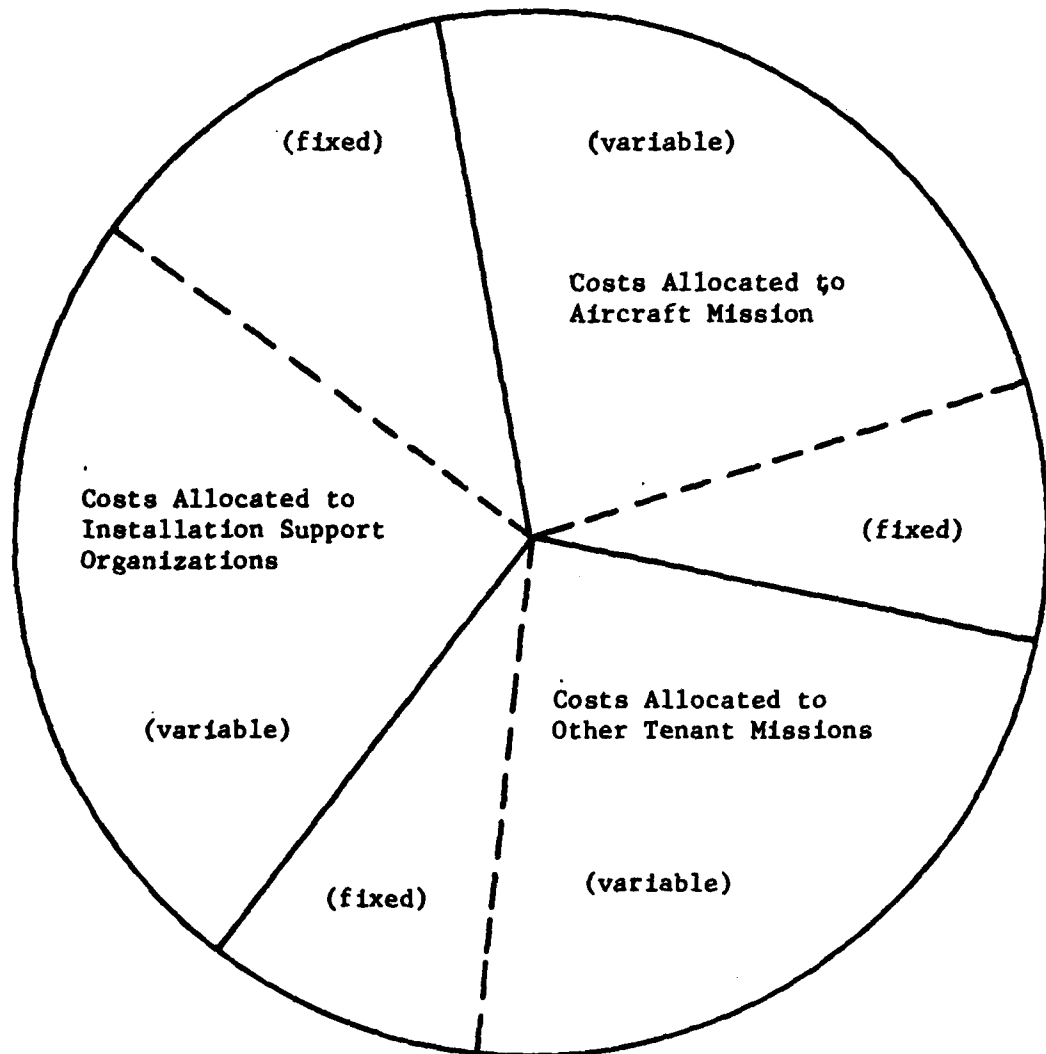


Figure 1: Allocation of Installation Support Costs

All aircraft operating and maintenance personnel are thus associated with specific MDS's, enabling WSSC to compute MDS-identified supported strength ratios which have the MDS-related strength in the numerator and the aircraft operating and maintenance strength in the denominator:

$$\frac{\text{Aircraft Operations and Maintenance Strength (CMD/GELOC/MDS)}}{\text{Aircraft Operations and Maintenance Strength (GELOC)}}$$

Multiplying each such ratio times the aircraft mission portion of installation support costs (as computed in the first step, described above) produces the share of base installation support allocated to each MDS.

#### B. INPUT DATA SOURCES

WSSC uses cost data from the H069R Accounting and Budget Distribution System (ABDS), and manpower data from the E300Z Advanced Personnel Data System (commonly referred to as MPC). In addition, in FY81, WSSC also used flying operations data from the G033B Aerospace Vehicle Inventory Status/Utilization Reporting System (AVISURS) as the basis for allocation of costs to MDS's. Cost data is selected from the ABDS file input to VAMOH for all seven relevant commands (TAC, MAC, SAC, ATC, AAC, AFE, and PAF) and also for LOG, SYS, and CSV commands.

Program Element Code (PEC) is used to determine the category of installation support:

XXX94 - Real property maintenance costs

XXX95 - Base communications costs funded by the host command

33112 - Base communications cost funded by CSV. These records must also have an RC/CC code of XX26XX (CEM Equipment Maintenance) or XX38XX (Communications Squadron).

35114 - Air traffic control costs. These records also must have an RC/CC code of XX26XX or XX38XX. Since air traffic control costs are entirely aircraft mission-related, they are not subjected to the preallocation which is applied to other cost categories (i.e., WSSC applies all 35114 costs to the aircraft mission).

XXX96 - Base operations support costs

Except where indicated above, all RC/CC's are accepted.

Element of Expense/Investment Codes (EEIC) were used to classify the FY81 expenditure functionally as follows:

20101	- Officer pay
20102	- Airman pay
391XX-394XX, 396XX	- Civilian pay
51XXX-59XXX	- Contract
60XXX-63XXX	- Materiel
All other EEIC's	- Other costs

For FY82, military personnel pay and allowance costs were computed using pay tables.

WSSC uses personnel strength data for the first step in the allocation. For each command/base combination in the seven relevant commands, personnel counts are extracted from the MPC input file using the Functional Account Code (FAC) to identify aircraft mission operations and maintenance personnel. Accepted FAC's include 13XX (except 1311), 20XX-25XX (except 2130 or 2140), 37XX, 2EXX, 2RXX, 2GXX, 435X, 4724 and 31XX (except 3120 or 3130). A FAC of 3130 is accepted for MAC and is also accepted for SAC when the PEC is 111XX or 11897. For FY81 all FAC 32XX records were accepted, but for FY82 only FAC 3280 records were allowed. WSSC uses the total base population count in computing strength ratios.

The flying hour and possessed hour data required in FY81 processing was selected from the AVISURS input file for each relevant command, base

and MDS combination. This data was summed across MDS and command to get the base-wide flying operations data for the allocation ratio described above.

#### IV. QUALITATIVE EVALUATION

This section examines the WSSC installation support algorithm in light of CAIG requirements and the conceptual framework laid out in Section II. Problem areas are discussed and, where appropriate, alternatives are presented. As previously mentioned, the evaluation described in this report is a qualitative one focused on the face validity of WSSC.

##### A. FACE VALIDITY

Comparison of the WSSC procedures for allocating installation support costs with the discussion in Section II of this report points up several discrepancies. First, CAIG desires that only the variable portion of the costs should be allocated. However, there is no provision in WSSC at present to break out the fixed and variable portions of the total cost figure. Second, by using the total base population in the denominator of the strength ratio used to define the aircraft mission's share of support costs, WSSC implicitly allocates back to an overhead function a portion of the overhead costs. Third, WSSC's initial extensive use of the flying operations ratio for MDS-level allocation, and its continued use in some areas, assumes that flying activity and number of planes are the underlying cost drivers that differentiate among MDS's. However, Desmatics contends that the number of supported personnel is the predominant cost driver of variable installation support costs. The following sections address these three topics.



## 1. Separating Fixed and Variable Installation Support Costs

Since fixed and variable indirect costs are not tracked separately in the Air Force accounting system, it is necessary to investigate ways of estimating the portion of the total costs that each represents. One way to estimate the fixed costs is to depict the minimal level of support activity required to keep a base open without regard to the presence of an operating mission. The Air Force OSCER system used this approach in defining a "typical base opening package." OSCER started with a servicewide average number of people required for keeping a base open. This number (1197) multiplied by the number of Air Force bases resulted in a figure approximately equal to the number of "fixed" installation support personnel in the service. This result in turn was divided by the servicewide total number of support personnel. The quotient was a factor that reflected the servicewide ratio of fixed-to-total installation support personnel. Then, for each base the total number of support personnel was apportioned into fixed and variable components using this factor.

The weakness of this approach lies in its reliance on 1197 as a constant. Documentation of its derivation is not available. Furthermore, from year to year as Air Force policy changes or as base services and personnel support needs change, this number would have to change. Depending on how the number was derived, it may not be feasible to revise it each year. However, the use of this kind of personnel ratio to apportion costs is consistent with the findings cited above that identify personnel as the primary cost driver of support costs.

Regression is a second method for estimating the fixed and variable components of installation support cost. An assumption underlying

application of this method is that, for any given base, as supported strength increased, the corresponding support costs would also increase according to some smooth relationship, at least approximately. This relationship might, for example, be in one of the three forms indicated in Figure 2.

Fortunately, statistical regression techniques are flexible enough to provide an adequate fit regardless of which underlying form is indicated by the data. For the three relationships indicated in Figure 2, regression equations of the following functional forms are indicated:

$$(1) \quad y = \alpha + \beta x$$

$$(2) \quad y = \alpha + \beta(1 - e^{-\gamma x})$$

$$(3) \quad y = \alpha e^{\beta x}$$

where  $y$  denotes installation support costs,  $x$  denotes supported strength, and  $\alpha$ ,  $\beta$  and  $\gamma$  are unknown parameters to be estimated.

It should be noted that in each of these three cases, the parameter  $\alpha$  represents the fixed cost associated with keeping a base open. The parameters  $\beta$  and  $\gamma$  indicate the relationship of variable costs to increases in supported strength. Estimates of these parameters, obtained from the regression process, may be used to apportion base support costs into fixed and variable components.

One specific approach, based on regression, would impose no additional data requirements on WSSC. This approach would use Air Force-wide data to compute an equation to approximate the relationship between installation support costs and number of personnel supported. The following paragraphs outline application of this approach, which could be incorporated into the WSSC logic.

Using servicewide data, regression estimates of the parameters  $\beta$  and  $\gamma$

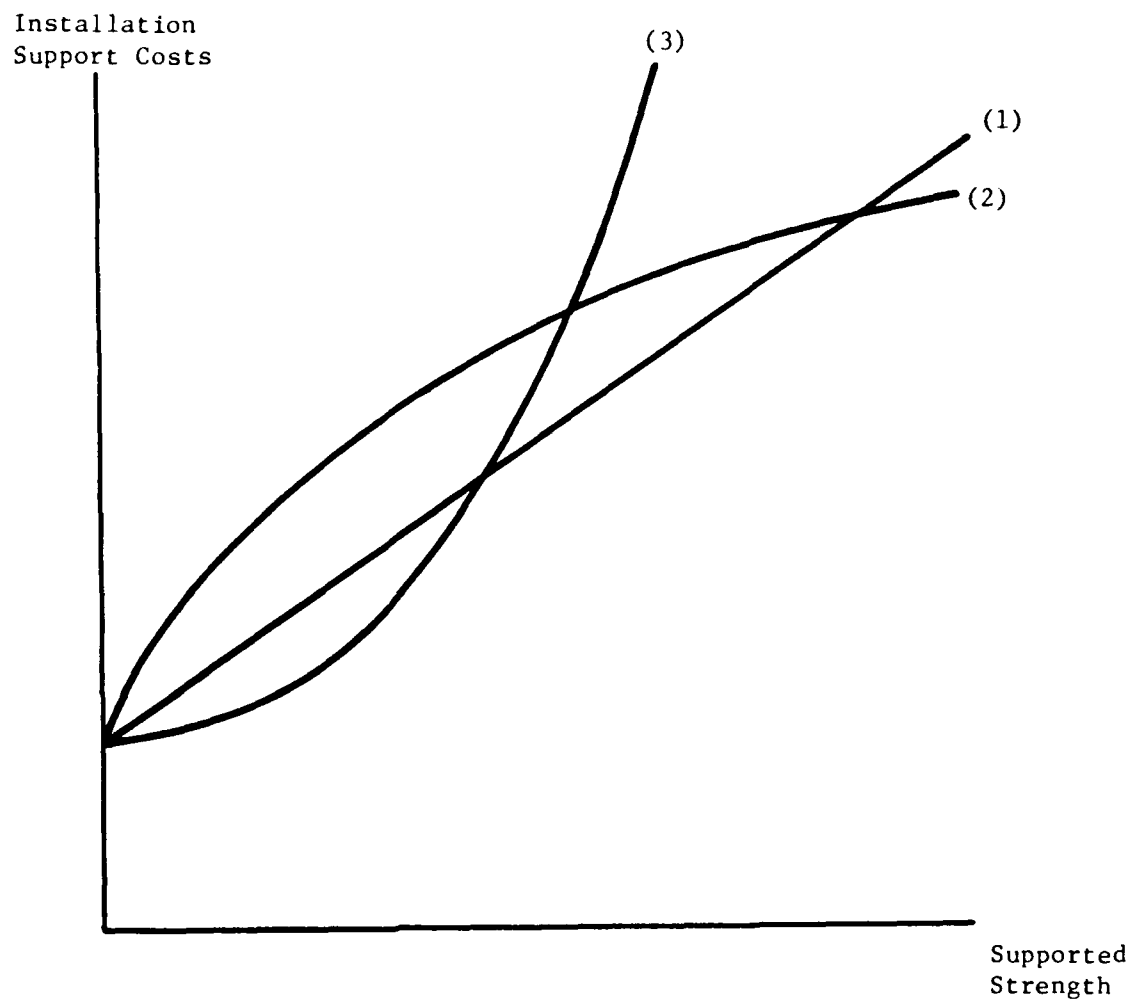


Figure 2: Three Possible Relationships Between Installation Support Costs and Supported Strength at a Particular Base

would be obtained. For each individual base, using these estimated parameters together with the observed support costs (y) and supported strength (x), a new intercept would be computed to estimate the fixed support costs for that particular base. The fixed cost dollar figure would then be subtracted from the total to get the variable portion to be used for subsequent levels of allocation. Each base would represent an adjusted regression equation (with a different intercept) on the graph "parallel" to the servicewide equation. Figure 3 provides an illustration of the application of this approach.

Two important assumptions are made when this method is used as described. First, it is assumed that although fixed costs may vary from base to base, any increments in installation support costs due to the variable components are incurred according to the same general relationship. Second, it is assumed that base-to-base variation in fixed costs is small in comparison with the variation in total installation support costs. An examination of these assumptions, based on FY81 and FY82 data, is currently in progress. A quantitative evaluation of the efficacy of this approach will be reported in Volume VII of this report series. An overview of the evaluation procedures is presented in [14].

If the conclusions indicate that the assumptions are not valid, this does not necessarily vitiate a more general regression approach. For example, such an approach might involve the grouping of bases into subsets that are relatively homogeneous with respect to the relationship between installation support costs and supported strength. In any event, if a regression approach is adopted, new regression equations should be fit every fiscal year as part of WSSC processing. In addition, it would be prudent to incorporate into the processing techniques for checking the underlying

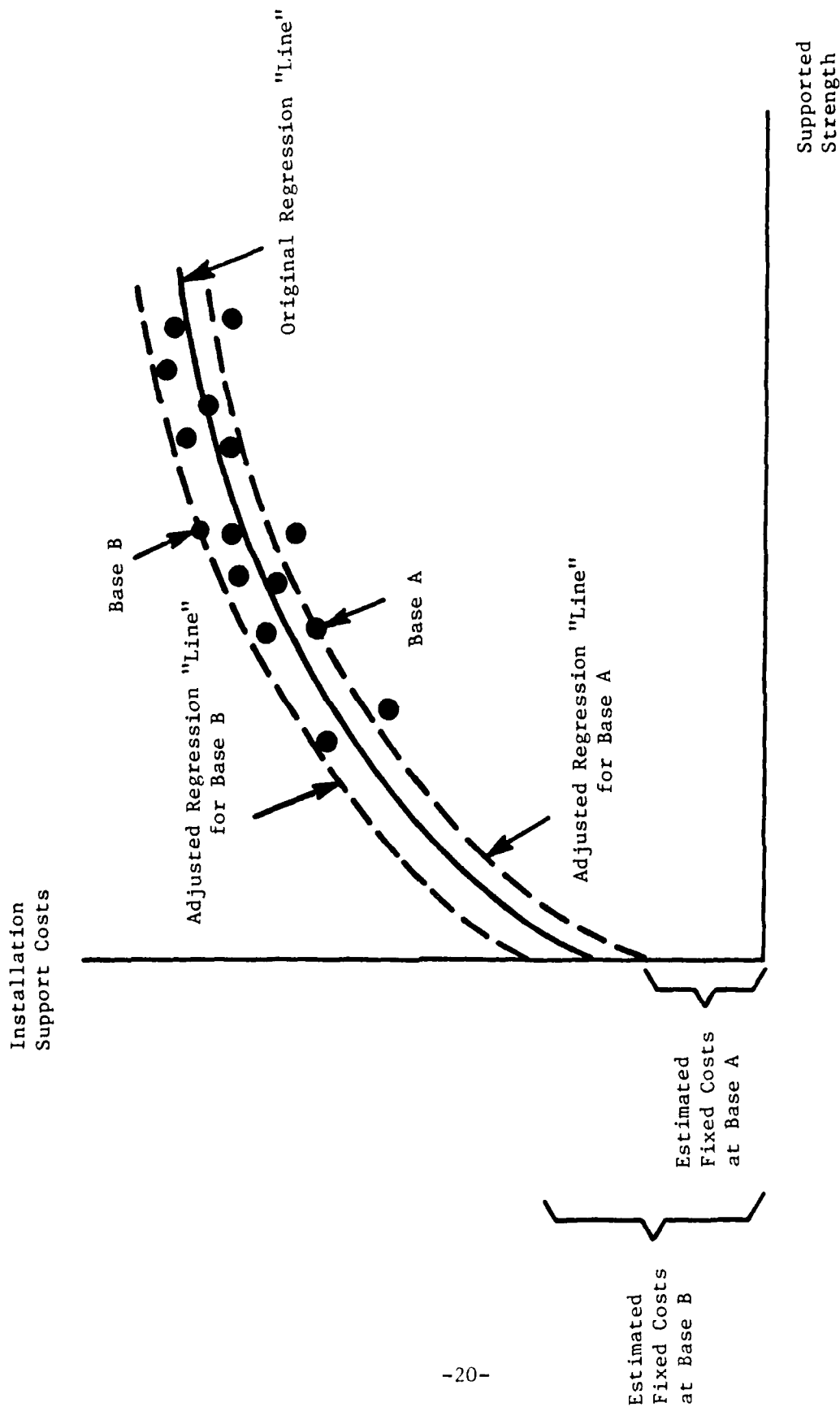


Figure 3: An Illustration of the Use of the Regression Method to Separate Fixed and Variable Installation Support Costs

assumptions to guard against unanticipated occurrences.

Of course, to incorporate any regression computations into WSSC would incur additional programming effort and cost. If it is decided that the outcome would not merit the expense, the costs allocated to an MDS could be overstated because of the inclusion of the fixed costs. Thus, it would be advisable to include an explicit notation to that effect in the WSSC documentation so that users will be aware of that constraint.

## 2. Allocation of Variable Costs to the Aircraft Mission

As mentioned previously, WSSC uses a personnel strength ratio to separate the share of installation support costs that should be attributed to the aircraft mission. Use of a strength ratio is consistent with the discussion that identifies supported personnel as the primary driver of support costs. However, as Figure 1 shows, in FY81 WSSC implicitly apportioned a share of installation support costs back on installation support personnel. The result is an understatement of the costs that should be attributed to the active missions, including the aircraft mission. (In reality, this understatement is combined with an overstatement that results from WSSC's not excluding a fixed portion of the costs from the allocation. Thus, the net effect is unknown.)

It is true that support personnel are to some degree consumers of support activity. However, mission personnel require support in order to function, and support personnel are present at a base only because mission personnel are there. The active missions should, therefore, absorb the support costs. The portion of the costs that should be attributed to the aircraft mission should be in proportion to the share of the total

base supported personnel they represent. A more appropriate strength ratio for WSSC is

$$\frac{\text{Aircraft Operations and Maintenance Strength}}{\text{Basewide Number of Supported Personnel}} .$$

The numerator of the ratio is unchanged from the current algorithm. The denominator, however, requires that a programming change be made. Data necessary to compute the revised denominator is currently part of the WSSC input. The change would require that WSSC first identify records for installation support personnel. These records will have installation support PEC's for identification. The number of installation support personnel may then be subtracted from the total base population as it is currently computed by WSSC to determine the value of the denominator.

### 3. Allocating Costs to MDS's

For FY81, WSSC used flying operations data to apportion the aircraft mission share of installation support costs among MDS's. Starting with FY82, WSSC shifted toward a supported strength ratio allocation basis along the line suggested in the preceding paragraph. However, it should be noted that, for FY82 at least, WSSC allocates command staff and other unit personnel to the MDS level using flying operations ratios. Thus, WSSC indirectly allocates a portion of installation support costs to MDS's on the basis of flying operations ratios.

Desmatics contends that supported strength is, in general, a more direct driving factor than flying operations data. Extending this concept to command staff and other personnel, it can be argued that it is better to allocate command staff and other personnel among MDS's in proportion

to crew counts for the MDS's. This agrees with the definition of command staff personnel given in AFR 400-31 Volume II [16] which indicates that command staff personnel engage in unit command, flying supervision, operations control, planning, scheduling, flight safety, aircrew quality control and unit administration.

An enhancement under consideration by the Office of VAMOSC for FY83 calls for the use of aircrew strength ratios as the basis for allocation of command staff personnel and other unit personnel to MDS's. This would place all of the installation support allocation on a supported personnel basis. Desmatics concurs with this modification.

#### 4. Replacement of the Two-Stage Allocation Process

Current WSSC processing allocates the variable portion of installation support costs to MDS's by means of a two-stage procedure. As noted previously, Desmatics contends that the form of the ratio used in the first stage should be changed so that costs are allocated only to supported personnel.

Furthermore, the allocation can be based on a one-stage procedure, rather than the two-stage process that WSSC now uses. The one-stage procedure would use ratios of the form:

$$\frac{\text{Aircraft Operations and Maintenance Strength (CMD/GELOC/MDS)}}{\text{Basewide Number of Supported Personnel}} .$$

Although a two-stage allocation would not be incorrect, Desmatics suggests that WSSC be revised to use a one-stage allocation. That revision would result in more efficient processing.



## 5. Identifying Air Traffic Control Costs

WSSC treats air traffic control costs (PEC 35114) as entirely aircraft mission-related, a procedure with which Desmatics concurs. However, the WSSC processing allocates all of these costs to aircraft of the seven relevant commands, which poses a difficulty.

Costs in PEC 35114 represent the total to provide control tower services to all aircraft using a base, including those from other than the seven relevant commands. The nonrelevant command share should, in Desmatics' opinion, be estimated and removed. This can be accomplished using ratios based on the number of aircraft landings, readily obtainable from the AVISURS system. Landings have high face validity as a measure of control tower service usage.

## 6. Treatment of Audio-Visual Personnel

For FY81, WSSC treated all FAC 32XX records as "other unit personnel." This FAC covers all types of audio-visual personnel, but it was determined by the Office of VAMOSC that only a small subset, namely FAC 3280 (armament recording system support) personnel are directly associated with the aircraft mission. Accordingly, WSSC processing was modified for FY82 to accept only FAC 3280 from the 32XX range.

FAC 32XX personnel who are not accepted as unit operations will be treated by WSSC as installation support if they have a support PEC code (XXX94, XXX95 or XXX96); otherwise, they will be dropped. Desmatics contends they should all be treated as installation support, regardless of PEC, and thus recommends that the processing be modified to insure that

all 32XX personnel except 3280 be treated as installation support, regardless of PEC.

#### B. SATISFACTION OF CAIG REQUIREMENTS

The CAIG guidelines indicate the types of information to be provided in each cost category. The guidelines are broadly written since they are to be used by all three services. Interpreting them to the level of specificity required for a particular application is not always straightforward. With this caveat given, there are some points raised by CAIG that are relevant to the installation support processing performed by WSSC.

As has been discussed, CAIG requires that only the variable costs be included in weapon system cost reports. For guidance, CAIG lists certain categories of costs that are to be excluded from the weapon system cost picture as they are "... dependent on the existence of the base...[and] are independent of the type and number of aircraft unit located there." [3] Those overhead costs which are independent of the size of a tenant organization in terms of personnel strength, or the number and complexity of weapon systems, are really fixed costs and should be excluded. However, it is Desmatics' opinion that most of such costs are not purely fixed or variable. Instead, they have fixed and variable components which can only be estimated. WSSC currently accepts as installation support, all costs (with a few exceptions) with PEC's of XXX94, XXX95, and XXX96. Thus, WSSC currently includes the fixed costs which CAIG would like to have omitted. However, a technique, such as described earlier in this volume, can be used to estimate and remove the fixed component.

Additionally, the CAIG guidelines indicated that "... non-cost (number

of people) estimates..." should be provided for installation support. Currently WSSC makes no provision for displaying the installation support work load distribution. The data necessary to do so, however, is available in the personnel input files; Desmatics recommends that these manpower counts be displayed in WSSC outputs. As with support cost allocation, the allocation of support personnel to MDS's should use only supported strength rather than base population in the ratio denominators.

#### C. APPROPRIATENESS OF INPUT DATA

There are two aspects of installation support data quality requiring consideration to insure that costs are not duplicated or incorrectly classified. The first problem relates to medical costs. WSSC employs a medical cost factor supplied by the Surgeon General. To avoid duplicating medical costs which might occur in the data received from the ABDS files, WSSC excludes records having an RC/CC code of XX5XXX. However, an examination of ABDS data by Desmatics has shown that there are still some medical/dental costs found in ABDS which will not be excluded on the basis of RC/CC code XX5XXX, namely those having an EEIC of 6X4. Desmatics recommends that these records also be excluded.

There is another area in which costs relating to installation support may be improperly classified by WSSC. AFR 170-5 [15] lists RC/CC codes for use in reporting host-financed support of tenant activities, all of which have RC codes of 9X and are generally used in conjunction with a PEC of XXX96. However, WSSC processing of cost records from the ABDS system examines only the middle two positions of the RC/CC code, and classifies records as unit operations if code XX13XX (excluding XX1311 and XX1312),

XX30XX, or XX37XX is found. As a result, the following two host-financed tenant support accounts currently will be treated as unit operations costs:

903700 - ATC Field and Mobile Training Detachments

933000 - Local Base Rescue Detachments

Desmatics has examined the 9XXXX-series of records in the FY81 ABDS files and has determined that the 903700 and 933000 codes occurred frequently and represented significant dollar amounts. It was observed that similar codes, such as 90370K, 90370P, 903710 and 993700 also occurred. These appear to be similar in nature to the ones specifically listed in AFR 170-5 as host-tenant BOS expenses, suggesting that the codes listed there are really more generic in nature, and might more correctly be listed as 9X30XX and 9X37XX. In addition, these codes were found to occur in all relevant commands and to contain EEIC's for military pay, travel and transportation, contract services, and supplies.

These two host-tenant BOS categories will not be treated as installation support by WSSC, regardless of the fact that they have a BOS PEC code. Desmatics takes no position as to whether these costs should be unit operations or installation support, but simply points out that these are examples of records which have ambiguous coding with respect to WSSC processing logic (i.e., the RC/CC implies they are unit operations while the PEC implies they are BOS). Desmatics recommends that these costs be reviewed by the Office of VAMOSC. If it is decided that they should be BOS, then these two specific six-digit RC/CC's will have to be included in BOS; otherwise, no change in processing is required.

## V. CONCLUSIONS, RECOMMENDATIONS AND OFFICE OF VAMOSC COMMENTS

This volume has presented a review and assessment of the processes within WSSC which select, classify, allocate and display installation support costs. Desmatics has approached the allocation of these overhead costs in light of cost accounting practices and user requirements.

### A. SUMMARY

Desmatics views installation support costs as consisting of two components: (1) variable elements which must be apportioned among tenants and ultimately to aircraft weapon systems, and (2) fixed elements which must be estimated and removed (or reported separately, if desired). Since the variable costs are not specifically identified with individual weapon systems, it is necessary to allocate portions of the support costs to the weapon systems on the basis of an associated parameter (or combination of parameters) having a valid relationship to the aircraft activity which gives rise to support requirements.

The WSSC system currently uses a personnel strength ratio to define that part of the total base support expenditure which should be borne by all aircraft weapon systems at the base. The part removed represents the shares for the other tenants of the base, but does not represent the fixed element of support cost. In FY81, WSSC allocated the aircraft portion among individual weapon systems on the basis of flying hours and possessed hours. While these two parameters are readily associated with specific aircraft, they have low face validity as cost drivers of installation support. In particular, there is little reason to believe that

installation support costs vary significantly with the percentage of total base flying hours contributed by each weapon system. It seems far more reasonable that the number of operations, maintenance, and command staff personnel determines the level of support cost incurred by the host organization. Thus, Desmatics concurs with the processing change implemented for FY82. This change bases this allocation primarily on personnel strengths.

#### B. RECOMMENDATIONS AND REPLIES

This section lists Desmatics' conclusions and recommendations regarding the WSSC installation support algorithms. The responses or comments provided by the Office of VAMOSC are also included.

##### 1. Treatment of Fixed Overhead Costs

Conclusion: CAIG calls for inclusion of only the variable installation support costs. Desmatics contends that fixed support costs cannot be uniquely identified. Rather, all such costs have fixed and variable components which can only be estimated.

Recommendation: The Office of VAMOSC should consider the use of techniques to estimate the fixed component of support costs so that they may be removed or displayed separately. Desmatics is investigating this possibility further, using WSSC FY81 and FY82 data. The results of this investigation will be reported in Volume VII.

Office of VAMOSC Comments: "Concur, pending receipt of Volume VII."

## 2. Allocation of Overhead Only to Supported Organizations

Conclusion: By using the total base population in the denominator of its strength ratios, WSSC inherently allocates a portion of support costs to overhead organizations.

Recommendation: The Office of VAMOSC should revise WSSC so costs are allocated entirely among the tenants receiving support. This can be accomplished by subtracting the support personnel strengths from the base population before use in the denominator of strength ratios.

Office of VAMOSC Comments: "Concur, pending implementation of Recommendation 1."

## 3. Replacing Flying Operations Ratios

Conclusion: Desmatics believes that supported strength is a more appropriate basis for allocation of support costs to MDS's than the use of flying operations ratios. Therefore, Desmatics concurs with the WSSC FY82 processing change which replaces flying operations ratios with supported strength ratios as the basis for allocation of support costs.

Recommendation: The Office of VAMOSC should continue to use supported strengths as the basis for allocating installation support costs to MDS's, but should allocate command staff and other unit strength proportional to crew strengths rather than by use of a flying operations ratio.

Office of VAMOSC Comments: "The face validity of this recommendation is very high. Desmatics, however, has conducted some further research, not described in this report, which raises some doubt about its universal applicability. More research is therefore called for before implementing this recommendation. The research will be completed as part of subsequent validation/verification taskings."

## 4. Use of a One-Stage Allocation Process

Conclusion: Current WSSC processing allocates variable installation support costs to MDS's by means of a two-stage procedure. Desmatics suggests the use of an equivalent one-stage allocation procedure, which should provide more efficient processing.

Recommendation: The Office of VAMOSC should replace the current two-stage allocation procedure with the suggested one-stage procedure.

Office of VAMOSC Comments: "Concur. Implementation will be held pending final redesign of all algorithms resulting from Phase I validation/verification effort."

#### 5. Treatment of Air Traffic Control Costs

Conclusion: WSSC allocates all of the air traffic control costs to relevant aircraft only, which means aircraft from nonrelevant commands do not share any of the burden of these costs.

Recommendation: The Office of VAMOSC should revise the WSSC processing to estimate and remove the nonrelevant command share of air traffic control costs. This can be done by using the number of landings (obtainable from AVISURS) as a basis for allocation.

Office of VAMOSC Comments: "Concur. Implementation will be completed for processing FY84 data."

#### 6. Displaying Support Manpower Data

Conclusion: WSSC reports do not display the numbers of support personnel employed. CAIG has indicated a desire for such manpower visibility.

Recommendation: The Office of VAMOSC should display manpower counts for installation support personnel on WSSC report products. In allocating support strengths to MDS's, supported strength should be used rather than base population as the ratio denominator.

Office of VAMOSC Comments: "Concur pending implementation of Recommendation 1."

#### 7. Duplication of Medical/Dental Costs

Conclusion: Spot checks of ABDS data indicate that some medical/dental costs, identified by EEIC 6X4, do not have an RC/CC of XX5XXX and will, therefore, appear in WSSC support cost files. Desmatics believes they will duplicate costs covered by the Surgeon General's health care factor.



Recommendation: Although the dollar amount of such duplicated costs is relatively small, the Office of VAMOSC should eliminate the duplication by excluding all EEIC 6X4 coded costs.

Office of VAMOSC Comments: "Concurrence withheld pending review by the Surgeon General."

#### 8. Classification of Host-Financed Tenant Activities

Conclusion: Desmatics contends that two specific types of host financed tenant expenses have "conflicting" coding (i.e., the RC/CC implies they are unit operations expenses, while the PEC implies they are BOS). Current WSSC logic treats them as unit operations.

Recommendation: The Office of VAMOSC should review costs assigned RC/CC codes of 903700 and 933000 to confirm whether they ought to continue to be treated as unit operations costs or should, instead, be treated as BOS.

Office of VAMOSC Comments: "Concur. Preliminary review of these costs indicates that 933000 expense should be added to MAC's XX3000 at those bases and 903700 to BOS. Research will continue for an FY84 implementation of any required changes."

#### 9. Treatment of Audio-Visual Personnel

Conclusion: Those Audio-Visual personnel (FAC 32XX, except 3280) not specifically included by WSSC as other unit personnel may or may not be treated as installation support, depending on the PEC code.

Recommendation: The Office of VAMOSC should insure that all such personnel are treated as installation support by altering the selection logic to specifically count them as BOS.

Office of VAMOSC Comments: "Concur. Implementation is scheduled for processing of FY84 data."

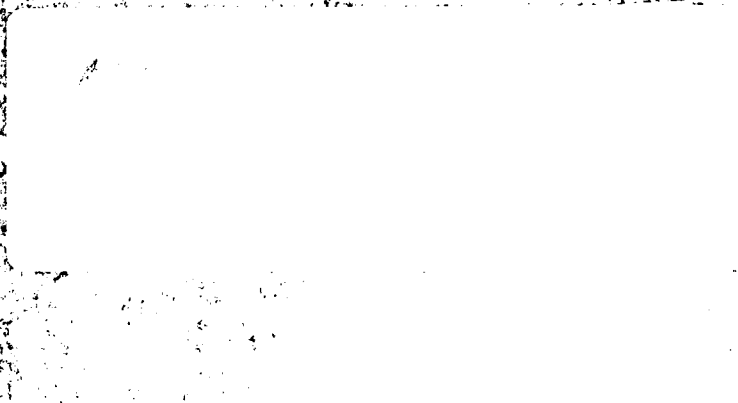
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